Docket No. **SA-509**

Exhibit No. 2C

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

USAIR DC-9 PILOT'S HANDBOOK
WEATHER RADAR

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Pages 3-41-1 through 3-41-3

SEVERE TURBULENCE

AVOIDANCE

Careful preflight planning and inflight analysis using all available information must be done to avoid severe turbulence. Although cruising altitudes available permit topping some thunderstorms and avoiding others, there are also other hazards to consider, such as clear air turbulence and reducing the margin between stall and mach buffet.

WEATHER RADAR

Airborne weather radar provides the most accurate, consistent information regarding the location of rain cells. Beyond the range of the radar, U.S. Weather Bureau radar and pilot reports should be used.

Carefully adjusting the radar for use is one key to having a picture that will help to circumnavigate storm cells. For the optimum picture, the adjustment procedures outlined in the Originating Check must have been completed.

The DC-9 is equipped with the Collins WXR-700X radar. This radar has a much more discrete beam width and greatly reduced side lobes and it is, therefore, more sensitive to antenna tilt adjustments. Antenna tilt should be adjusted as follows:

— In preparation for takeoff, adjust the antenna for a setting of 3° upward tilt. This will provide target detection up to 40 NM without excessive ground returns and eliminates frequent tilt adjustments. Engaging the IDNT function will suppress ground clutter. Due to precession error caused by acceleration during takeoff, ground clutter supression will reduce the intensity of the ground return, enabling the pilot to more easily identify weather targets. Ground clutter suppression (IDNT) should not be used during normal operation, as it may also suppress some weather targets.

— The tilt settings should be changed to optimize any targets that are encountered. If there is significant weather activity, the tilt angle should be adjusted to provide a solid ground return outside of the desired range to ensure that no overscanning will occur.

— The tilt angle of the antenna, while scanning for weather target, depends upon aircraft altitude and the range selected. The best general guideline is to tilt the antenna downward until a small amount of ground return appears at the outer edge of the display.

— When storm targets are detected, the antenna tilt should be adjusted with care, up and down, to locate the level of the most intense activity within the storm. When this level is found, remember that the returns behind the cell may extend further back than is shown on the indicator display.

WEATHER RADAR (cont'd.)

— The WXR-700X radar does not have a contour mode; however, red returns are displaying the same level of rainfall as contour. The system is also equipped with turbulence detection that will show areas of rainfall movement which is usually associated with turbulence, and will be depicted in magenta. This will be annunciated as WX+T and is enabled only in the 50 or 25 NM ranges. Specific rainfall rates are shown in green, yellow, red, and magenta.

— Active Gain in WX mode is normally operated in the CALibrated position. It may, however, be positioned to MAX or −1 thru −7 or MIN. This will increase the receiver's sensitivity to targets within 80 NM of the aircraft. When selected to other than the CALibrated position, weather returns will appear more intense.

NOTE: PAC ALERT (attenuation warning) is disabled when out of the CALibrated position.

— Be aware of the effect of areas of heavy precipitation masking returns from storms farther away. While the X-band radar is excellent for detecting storm areas, the radar energy is attenuated by rainfall, the degree of degradation increasing rapidly when the precipitation between the storm cell and the radar antenna increases from "moderate" to "heavy". When the aircraft is in an area free of precipitation, the radar is excellent for detecting and evading turbulence, but once in rainfall, its usefulness is diminished. It is not as satisfactory for use as a storm penetration aid.

— The PAC Alert annunciation identifies areas of severe attenuation. Should the intervening precipitation be so intense that the signal is attenuated below the minimum discernible signal level, a yellow arc (PAC Alert bar) is painted at the outermost range mark to indicate the azimuth direction where heavy precipitation is encountered. The targets displayed beyond the intervening storm cell in this direction may not be accurately displayed. This is available only within 80 NM of the aircraft, regardless of range selected and only when in CALibrated Gain.

— Areas which show the greatest change in rainfall rate will be displayed as narrow bands of color running close together. This indicates a steep gradient; where as, wide bands of color indicate more gradual gradients of rainfall rate. The narrower bands, or steeper the gradient, the greater the turbulence associated with the area.

— Scalloped edges of a return also indicate the presence of hail. Hail itself does not provide a good return and may not be visible on the indicator unless covered by a coating of water. Hail can be encountered at any altitude, even when flying between storm cells or under an anvil top of a thunderstorm. Any thunderstorm topping 25,000 feet can be a hail producer. A thunderstorm reaching 35,000 feet can be just as severe as a super cell reaching 60,000 feet.

WEATHER RADAR (cont'd.)

— Provide reasonable clearance around rain areas by selecting a heading which will clear storm cells by:

  — 5 miles when OAT is above freezing.
  — 10 miles when OAT is below freezing.
  — 20 miles when at or above 25,000 feet.

— Prior to commencing descent from cruise altitude in aircraft equipped with the Collins WXR-700X radar, select desired range and adjust antenna tilt to 0°. During the descent, adjust the tilt up so that the following schedule is met:

  — 30,000 feet — 1°
  — 20,000 feet — 1° up
  — 10,000 feet — 2° up

  Use the schedule as a guide to keep the scope relatively free from ground clutter. In mountainous terrain, more tilt may be required.

BEFORE ENTERING KNOWN TURBULENCE

Knowledge of adequate maneuvering margins, determination of best penetration altitude and heading, and common sense are all criteria for this type operation.

Establish target penetration speed. Above 10,000 feet, fly at 285 knots to M.76. Do not chase airspeed.

Fly attitude, "fly loose", sacrificing altitude to maintain attitude. Do not chase altitude.

Maintain thrust which gives target speed in smooth air to minimize pitch changes and deviations in speed and altitude. Change only with extreme airspeed variation.

Use ignition if entering areas of known heavy turbulence and precipitation or when encountering moderate to severe turbulence in clear air.

USE OF AUTOPILOT

With the autopilot engaged, pitch hold mode shall be used (aircraft in level flight attitude). Having the autopilot engaged in turbulence has several advantages:

— Control force application will be moderate, minimizing the additional "G" forces imposed on the aircraft.

— It allows the flight crew more time to thoroughly monitor flight operations.

Monitoring stabilizer trim position is required when using the autopilot corrections in the pitch axis since this might impose high "G" loads on the aircraft.